

A Home-Made Sprayer

*for Attachment to a
Tractor Power Take-Off*

by H. ANDISON

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A HOME-MADE SPRAYER FOR ATTACHMENT TO A TRACTOR POWER TAKE-OFF¹

by
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A sprayer for insect control operated by tractor power take-off (Figure 1) is easy to assemble on the farm at a cost of about \$165 for parts. It is simple in operation, as it is made to connect directly to the power-take-off spline and the spray tank rests on the drawbar or a platform on the rear of the tractor. The operator can control the sprayer from the driver's seat. Pressures from 0 to 400 pounds, suitable for spraying row crops, shrubs, small trees, and cattle, can be obtained. This article describes the assembling of such a unit that was designed and built at the Entomology Laboratory, Science Service, Victoria, B. C., during investigations on the control of the narcissus bulb fly.

A spray unit of this type, although primarily developed for pest control on row crops, has many other uses on the farm. With a few minor adjustments it may be used for spraying weeds, dairy barns, and poultry houses, for irrigation, and, in an emergency, for fighting fires. It is not suitable for spraying large orchards.

The equipment consists of a small piston pump that operates directly from the power-take-off spline on the tractor; a 45-gallon oil drum to serve as a spray tank; and two adjustable U-shaped spray booms, each fitted with 3 nozzles for

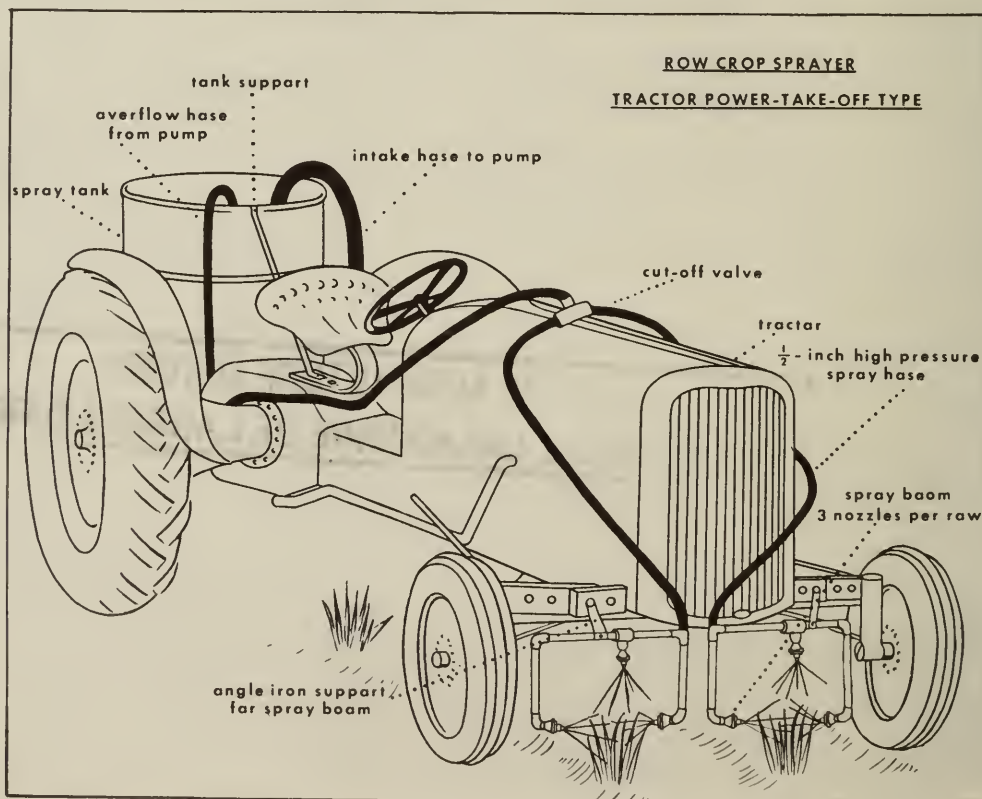


Figure 1. Row crop sprayer of power-take-off type assembled on tractor, showing position of spray tank resting on drawbar and spray boom mounted in front of wheels.

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spraying 2 rows at a time. The spray booms are suspended horizontally from the frame at each side of the tractor so that the operator can readily see the spray nozzles.

EQUIPMENT NEEDED

The equipment needed to build a spray unit of the type described includes:-

1. A pump to provide the pressure.
2. A mounting to attach the pump to the tractor.
3. A supply tank of convenient size.
4. A by-pass or relief valve.
5. A filter or a strainer to keep the nozzles from becoming clogged.
6. A device for agitating the spray material in the supply tank.
7. An adjustable 2-row spray boom with 3 nozzles per row, and attachments for mounting it on the tractor.
8. A pressure gauge.
9. Sufficient hose to connect the supply tank to the pump and the pump to the spray boom
10. A cut-off or a gate valve.

PUMP

Piston-type pumps (Figure 2) that develop and maintain the desired pressure are the most satisfactory. The gear, centrifugal, and rubber-impeller types usually weigh less, have fewer working parts, and cost less than the piston types of similar capacity but are not the best for home-made spray units. For spraying row crops and trees the pump should have a capacity of 7 to 8 imperial gallons per minute at 100 pounds' pressure when operated at 500 r.p.m. Pumps with a $\frac{3}{4}$ -inch intake and a $\frac{1}{2}$ -inch discharge are best for this type of unit. The difference in price between the four-piston and the two-piston pumps is so small that the few extra dollars are worth while to ensure ample capacity for the purpose.

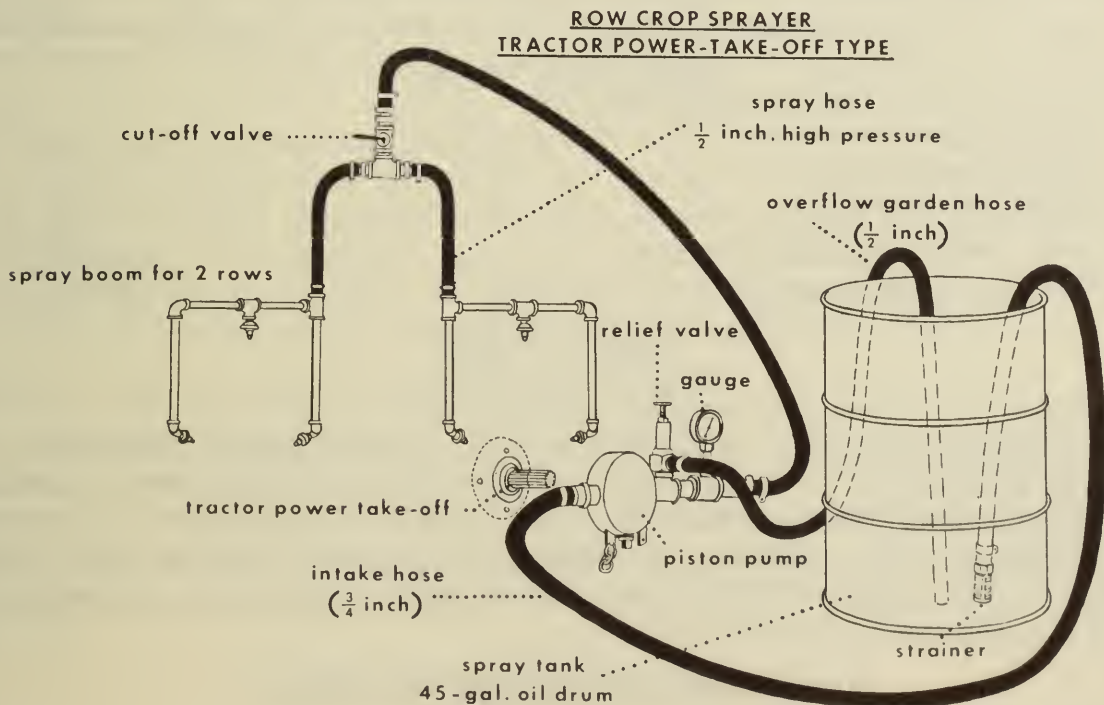


Figure 2. Row crop sprayer unit, showing relative positions of pump, spray tank, boom, cut-off valves, and hoses.

Suitable four-piston pumps are available that are fitted with couplings for direct power take-off. When operated at 550 r.p.m., these deliver 8 imperial gallons per minute at a pressure of 0 to 400 pounds per square inch. Pumps of this type now cost about \$120. Performance data of these piston pumps at varying tractor spline revolutions per minute are shown in Table 1.

TABLE 1

Performance data of piston pumps for direct power take-off

r.p.m.	Gallons per minute at 0 to 400 lb. pressure	
	Four-piston pump	Two-piston pump
200	3.0	1.5
300	4.5	2.2
400	6.0	3.0
500	7.5	3.7
550	8.0	4.0

ATTACHING THE PUMP TO THE TRACTOR

The most convenient type of piston pump is one that can be attached directly to the tractor spline by means of an inexpensive coupling. A single screw-pin holds the pump on the spline, on which the pump is suspended, and no base or solid platform support is required. Consequently, the unit is quickly and easily attached to the tractor.

The size of spline varies with the make of tractor, and the coupling for the pump must be of the corresponding size. The following spline sizes are listed for some of the various types of tractors that have a spline operating at approximately 200 to 550 r.p.m. at low to medium throttle:-

John Deere G	1 3/4 inches
Massey Harris 30	1 3/8 "
Massey Harris Pony	1 1/8 "
Ford, Ford-Ferguson, Ferguson	1 1/8 "
International Harvester Cub	15/16 "

SUPPLY TANK

Any type of metal tank or barrel may be used for holding the spray material. A second-hand 45-gallon oil drum (Figure 2) is a convenient and inexpensive type to use on a tractor. It is not necessary to remove the top of the barrel or drum, as the intake and overflow hoses can be passed through the large screw-cap openings. The piston type pumps mentioned are self-priming and lift water at least 15 feet, but more uniform pressure is obtained when the tank is mounted in a position that allows full gravity flow into the pump.

BY-PASS OR RELIEF VALVE

The relief or by-pass valve (Figure 3) is necessary on any positive-action pump to prevent damage when the discharge opening is closed while the pump is operating. The most economical type is one graduated from 0 to 400 pounds'

pressure, as a pressure gauge is not necessary with it. Graduated relief valves of this kind cost about \$5.

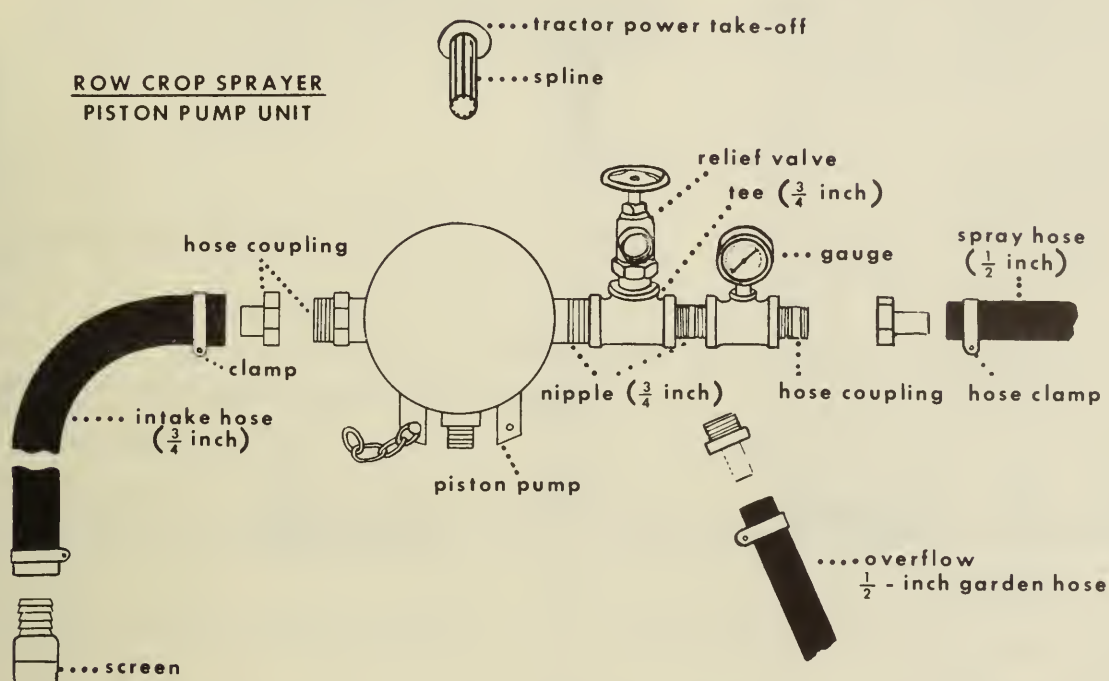


Figure 3. Piston pump unit, including relief valve, pressure gauge, power-take-off coupling, and hose connections.

FILTER OR STRAINER

To prevent rust scales or foreign materials from damaging the pump and clogging the nozzles, a filter or a strainer is necessary. Attach it to the inlet of the intake hose as in Figure 2. The strainer should have about 32-mesh copper or brass screening wire.

SPRAY AGITATOR

Some materials such as wettable powders must be mixed continuously in the spray tank to prevent them from settling. The spray mixture is agitated by the discharge or overflow returning to the tank through the relief or by-pass valve. While the pump is in operation, liquid that is not forced into the spray boom is by-passed back into the tank. An 8-foot length of 1/2-inch garden hose from the relief valve to the spray tank serves the purpose, as shown in Figure 2.

PRESSURE GAUGE

A pressure gauge (Figure 3) is necessary to ensure an accurate rate of application if a graduated relief valve is not used. It is best to have a gauge reading from 0 to 600 pounds. A low-pressure gauge is likely to be damaged if a pressure beyond its capacity is accidentally applied. Suitable gauges cost approximately \$4. Location of the gauge in the assembled pump unit is shown in Figure 3.

SPRAY BOOM AND BOOM MOUNTINGS

The adjustable type of boom described (Figure 2) will spray 2 rows at a time. It consists of 2 U-shaped units (Figure 4) made of 1/4-inch galvanized pipe connected to a single tee (Figure 5) by 2 pieces of 1/2-inch high-pressure hose, each 5 feet long. The U-shaped section of the boom is about 22 inches wide,

has side arms 12 inches long, and is fitted with 3 nozzles. The nozzles are of the cone type with $\frac{1}{4}$ -inch female fittings. One is attached to a $\frac{1}{4}$ -inch tee-connection in the center of the U-shaped unit and the other two are threaded onto street elbows at each end of the unit. The use of street elbows on each arm of the boom enables the nozzles to be adjusted at various angles so that the direction of the spray can be altered readily. The best coverage of row-crop foliage for insect control is obtained with a full-cone type of nozzle, not with those that produce a flat or a fan-shaped pattern. These nozzles may be secured with holes or apertures of various sizes to give almost any desired rate of application per acre.

Suspend the U-shaped sections of the boom at the front of the tractor by short pieces of angle-iron fastened horizontally to the frame of the tractor, in front of the wheels. Place the center nozzle of each boom

above the center of a row so that the two lower nozzles are approximately 8 inches above the soil surface. When the tractor reaches the end of the row, turn the simple gate or cut-off valve (Figure 2) to stop the flow of spray into the boom. Allow the pump to continue to operate so that it pumps the spray through the relief valve back into the tank. Fasten the cut-off valve either on the engine hood or to the steering column of the tractor within easy reach of the operator. Figure 1 shows one method of attaching the boom in front of the front wheels of a tractor. The method of attaching the boom will vary with the make of tractor and can be easily adapted by the grower.

SPRAY BOOM FOR ROW CROP SPRAYER PARTS REQUIRED TO MAKE 3- NOZZLE BOOM WITH $\frac{1}{4}$ - INCH GALVANIZED PIPE

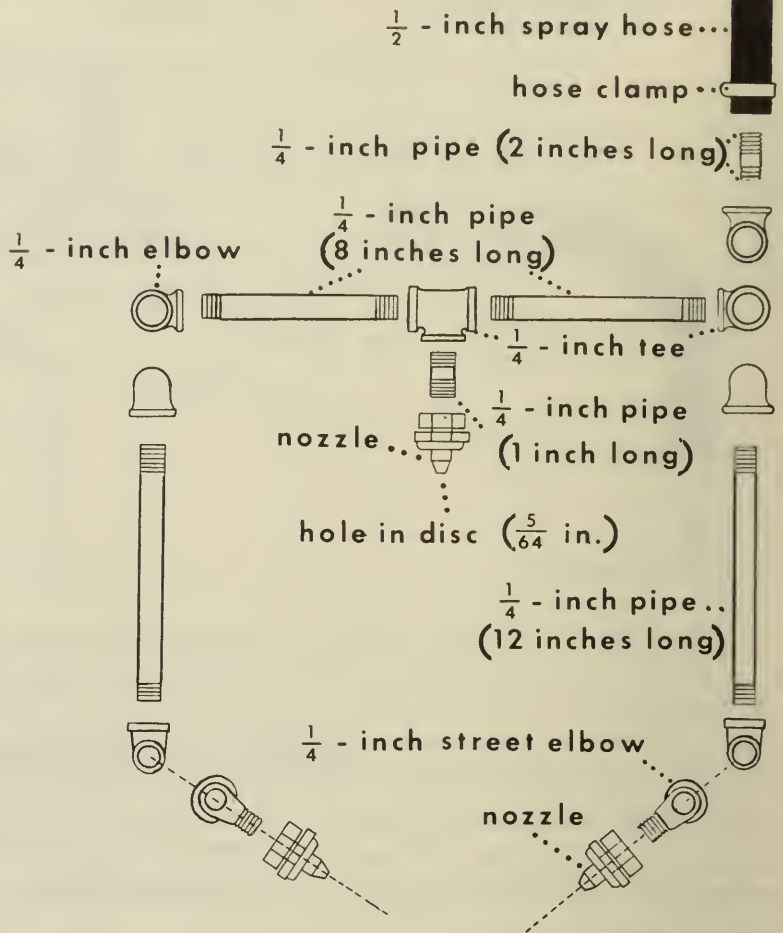


Figure 4. Spray boom for row crop sprayer, showing exploded view of parts required to make 3-nozzle boom with $\frac{1}{4}$ -inch galvanized pipe.

RATE OF APPLICATION PER ACRE FOR CROP ROWS THREE FEET APART

In order that the sprayer may deliver 200 gallons of spray per acre when the pump is operating at 100 pounds' pressure and the tractor is travelling $2\frac{1}{2}$ miles per hour at medium throttle, it is recommended that full-cone type discs or orifice

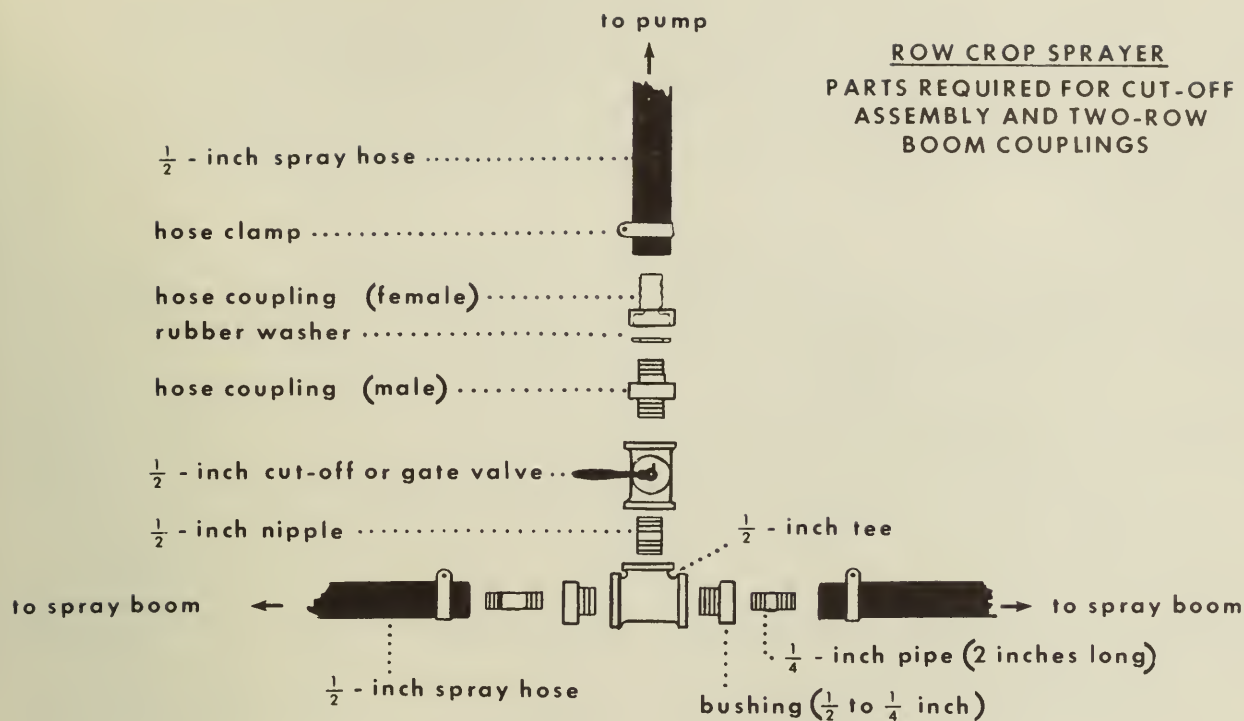


Figure 5. Parts required for cut-off valve assembly and two-row boom couplings.

tips of .062 inch be used in the nozzles. After the sprayer is built, check the exact rate of application as follows: Start the tractor and, with the pump operating at 100 pounds' pressure and the tractor running at low throttle, catch the liquid discharged under 1 nozzle for 1 minute. Measure the amount of liquid discharged and multiply this by the number of nozzles. Now establish the tractor speed by having someone walk alongside counting the number of yards (or paces) travelled per minute. Approximately 30 yards per minute is equivalent to a speed of 1 mile an hour. In other words, when the tractor is travelling in second gear at $2\frac{1}{2}$ miles an hour (75 yards per minute) each nozzle should deliver approximately 1 gallon, or the 3 nozzles a total of 3 gallons per row, per minute to apply 200 gallons per acre for rows 3 feet apart.

Where only 100 gallons of spray per acre is required, use a full-cone type orifice tip of .052 instead of .062 inch and travel at $2\frac{1}{2}$ miles per hour, as shown in Table 2.

TABLE 2
Performance data of nozzles with full-cone
spray pattern for spraying row crops

Spray pressure per square inch	100 p.s.i.	200 p.s.i.
Diameter of nozzle orifice	.052 inch	.062 inch
Gallons per minute per nozzle	0.5	1.0
Gallons per acre using 3 nozzles per row for rows 3 ft. apart at tractor speed of 2 mi. per hour	/	
2.5 " " "	120	240
3.0 " " "	100	200
4.0 " " "	80	160
	60	120

While spraying with the pump set at 100 pounds' pressure, you may find that the particular size of nozzle used will not give exactly the desired discharge at a certain tractor speed. If less spray material than required is being applied per acre, decrease the speed of the tractor. If too much material is being applied, increase the tractor speed. After a few trials you will obtain the desired speed and may mark the tractor throttle in order to duplicate the speed during future operations.

LIST AND COST OF PARTS

Pump and Accessories	Approximate Cost
1 Pump	\$120.00
1 Power-take-off coupling	4.50
1 Adjustable by-pass valve.....	8.00
1 Gauge, 0 to 600 pounds	4.00
1 Bushing, 1¼ x ¾ inch.....	.35
1 Tee, ¾ inch .....	.65
1 Tee, ¾ x ¼ inch .....	.60
2 Close nipples, ¾ x 1½ inch.....	.60
2 Hose couplings, ¾ inch	1.00
1 Hose coupling, ¾-inch pipe by ½-inch hose .....	.50
Spray Boom and Cut-Off Assembly	
4 Tees, ¼ x ¼ x ¼ inch.....	.72
1 Tee, ½ x ½ x ½ inch .....	.42
2 Elbows, ¼ inch .....	.30
14 Street elbows, ¼ inch.....	3.60
2 Bushings, ½ x ¼ inch.....	.30
4 Nipples, ¼ x 2 inch .....	.40
1 Nipple, ½ x 2 inch .....	.15
1 Hose coupling, ½ inch .....	.41
1 Cut-off or gate valve, ½ inch	1.50
8 ft Pipe, ¼ inch .....	.40
6 Nozzles, cone type	8.40
12 ft. High-pressure spray hose, ½ inch.....	2.70
9 ft Garden hose, ½ inch .....	.50
9 ft. Water hose, ¾ inch	2.70
3 Female hose connections, ½ inch	1.00
1 Male hose connection, ½ inch	
7 Hose clamps, ½ inch .....	.50
2 Hose clamps, ¾ inch	
Cost of parts for complete spray unit	\$164.20

For further information write to the Crop Insect Unit, Entomology Division, Department of Agriculture, Ottawa, Canada, or to the Entomology Laboratory, Victoria, B. C.